National Institute of Environmental Health Sciences

The effects on human health from stratospheric ozone depletion and its inter-actions with climate change

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Abstract:

Ozone depletion leads to an increase in the ultraviolet-B (UV-B) component (280-315 nm) of solar ultraviolet radiation (UVR) reaching the surface of the Earth with important consequences for human health. Solar UVR has many harmful and some beneficial effects on individuals and, in this review, information mainly published since the previous report in 2003 (F. R. de Gruijl, J. Longstreth, M. Norval, A. P. Cullen, H. Slaper, M. L. Kripke, Y. Takizawa and J. C. van der Leun, Photochem. Photobiol. Sci., 2003, 2, pp. 16-28) is discussed. The eye is exposed directly to sunlight and this can result in acute or long-term damage. Studying how UV-B interacts with the surface land internal structures of the eye has led to a further understanding of the location and pathogenesis of a number of ocular diseases, including pterygium and cataract. The skin is also exposed directly, to solar UVR, and the development of skin cancer is the main adverse health outcome of excessive UVR exposure. Skin cancer is the most common form of malignancy amongst fair-skinned people, and its incidence has increased markedly in recent decades. Projections consistently indicate a further doubling in the next ten years. It is recognised that genetic factors in addition to those controlling pigment variation can modulate the response of an individual to UVR. Several of the genetic factors affecting susceptibility to the development of squamous cell carcinoma, basal cell carcinoma and melanoma have been identified. Exposure to solar UVR down-regulates immune responses, in the skin and systemically, by a combination of mechanisms including the generation of particularly potent subsets of T regulatory cells. Such immunosuppression is known to be a crucial factor in the generation of skin cancers. Apart from a detrimental effect on infections caused by some members of the herpesvirus and papillomavirus families, the impact of UV-induced immunosuppression on other microbial diseases and vaccination efficacy is not clear. One important beneficial effect of solar UV-B is its contribution to the cutaneous synthesis of vitamin D, recognised to be a crucial hormone for bone health and for other aspects of general health. There is accumulating evidence that UVR exposure, either directly or via stimulation of vitamin D production, has protective effects on the development of some autoimmune diseases, including multiple sclerosis and type 1 diabetes. Adequate vitamin D may also be protective for the development of several internal cancers and infections. Difficulties associated with balancing the positive effects of vitamin D with the negative effects of too much exposure to solar UV-B are considered. Various strategies that can be adopted by the individual to protect against excessive exposure of the eye or the skin to sunlight are suggested. Finally, possible interactions between ozone depletion and climate warming are outlined briefly, as well as how these might influence human behaviour with regard to sun exposure.

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Resource Description

Exposure : ☑

weather or climate related pathway by which climate change affects health

Air Pollution, Solar Radiation

Air Pollution: Ozone

Geographic Feature: ☑

resource focuses on specific type of geography

None or Unspecified

Geographic Location: ☑

resource focuses on specific location

Global or Unspecified

Health Impact: ☑

specification of health effect or disease related to climate change exposure

Cancer, Other Health Impact

Other Health Impact: eye diseases

Intervention: ☑

strategy to prepare for or reduce the impact of climate change on health

A focus of content

Mitigation/Adaptation: ☑

mitigation or adaptation strategy is a focus of resource

Adaptation

Resource Type: ☑

format or standard characteristic of resource

Review

Timescale: ☑

time period studied

Time Scale Unspecified

Vulnerability/Impact Assessment: ☑

resource focus on process of identifying, quantifying, and prioritizing vulnerabilities in a system

A focus of content